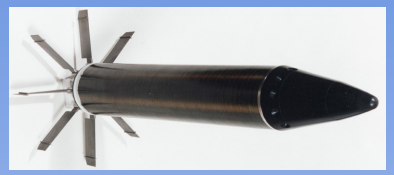

# AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)

# NDIA Gun & Ammo Conference

## 15 April 2004


**Presented By:**

**Mr. Erik Ballinger**

**Senior Engineer, Strategy and Business Development**



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# Briefing Purpose

- **Provide a summary of the AARGM/Quick Bolt demonstration programs**
- **Provide an overview and status of the AGM-88E AARGM system development and demonstration (SD&D) program**
- **Support Q&A**

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# Summary of AARGM/Quick Bolt Demonstrations

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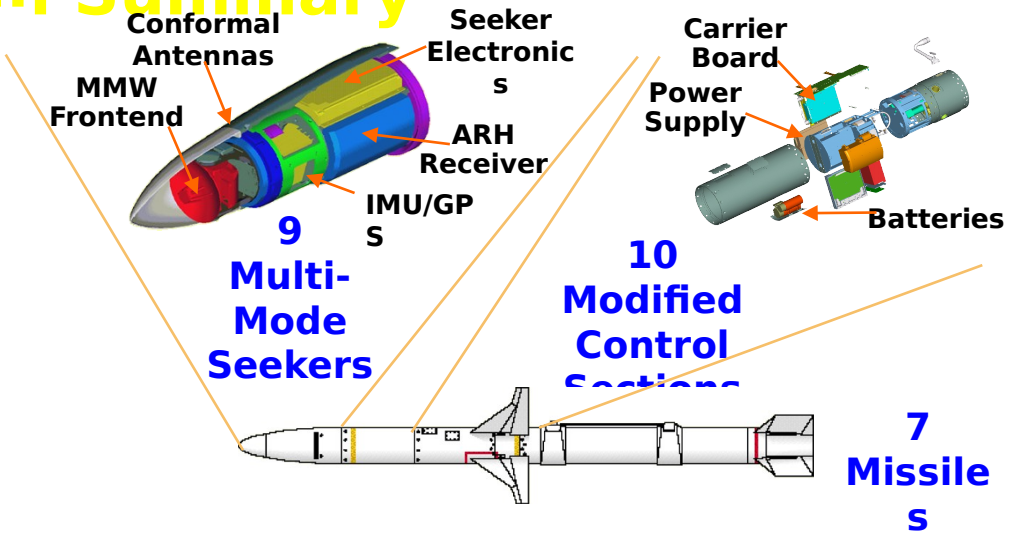
# AARGM Advanced Technology Demonstration
## Program Summary

- Form-factored AARGM seeker design/fabrication
  - Passive ARH sensor
  - Active MMW sensor
  - GPS inertial navigation
  - Fused INS/ARH/MMW guidance
- AARGM seeker integration with the existing HARM airframe (AGM-88)
- Test and evaluation efforts
  - Chamber Testing
  - Hardware-in-The Loop
  - Brassboard captive flight tests
  - Control test vehicle firings
  - Guided test vehicle firings
    - Including Shutdown Scenario



***ATD successfully demonstrated defeat of target shutdown with a multi-mode guidance section upgrade to HARM***

# Quick Bolt ACTD

## Objectives

- **Demonstrate:**
  - **Improved target location capability & pilot situational awareness**
  - **Support for bomb damage assessment efforts**
  - **Improved lethality and reduced fratricide potential**
- **Enhance baseline AARGM ATD design and provide risk reduction for AARGM SD&D**

## Sponsor: USEUCOM

## System Concept

- **Integrate the Weapons Impact Assessment (WIA) Transmitter with the ATD design AARGM for connectivity between AARGM, National Technical Means, and IBS**
- **Integrate the ENTR Receiver and Producibility ARH full band antenna on a Captive Air Training Missile (CATM) for IBS connectivity to the aircraft**

## Program Status

- **Successfully demonstrated Quick Bolt capabilities via HWIL, ground, captive carry testing and 2 live fire tests (11/15/02, 7/15/03)**
- **Delivered Residuals - 1 CATM and 1 Quick Bolt Missile**
- **Completed successful Military Utility Assessment by EUCOM**

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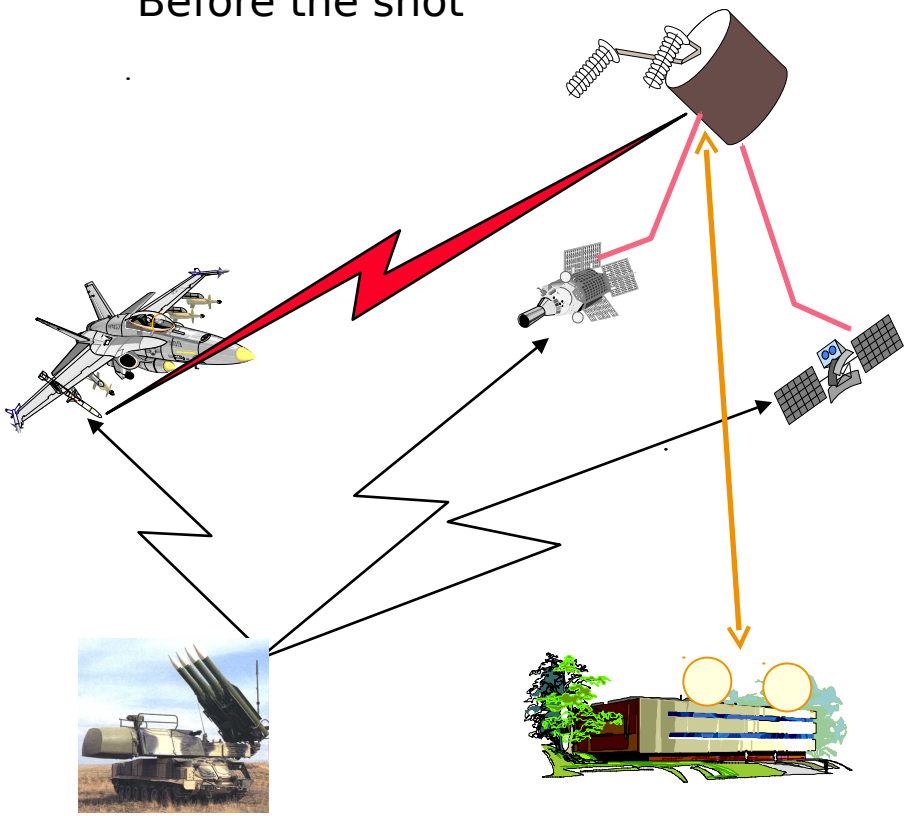
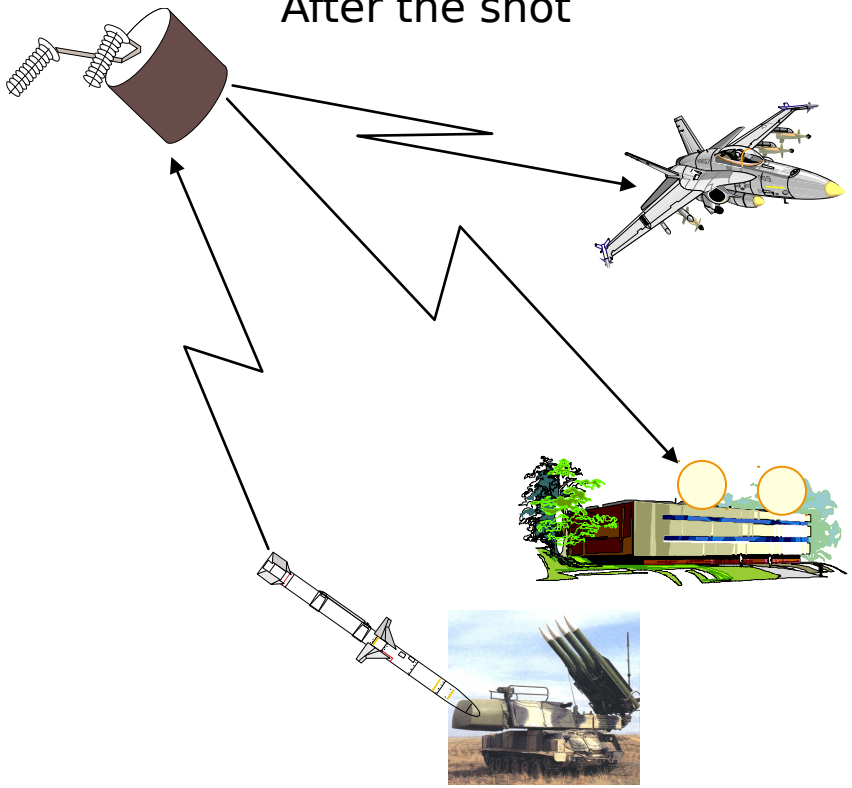
# Quick Bolt Network Centric
## Sensor-to-Weapon-to-Sensor Solution

Before the shot

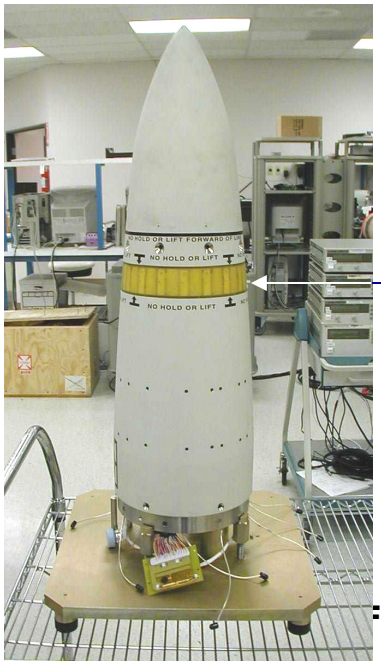


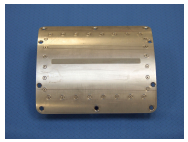
After the shot



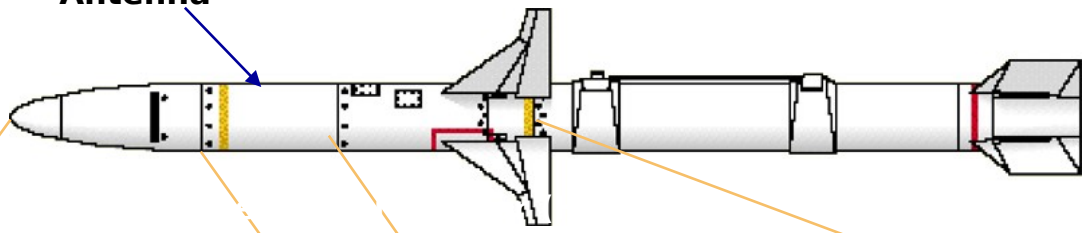
*a Net-centric Warfare capability to Tactical A*

# Quick Bolt ACTD Missile Configuration
## AARGM ATD Missile + WIA Transmitter





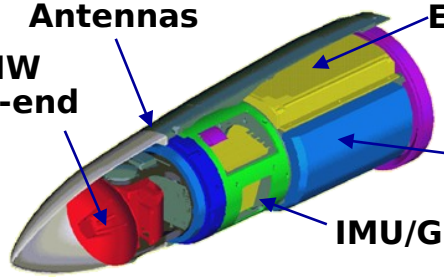
WIA Antenna



Conformal Antennas

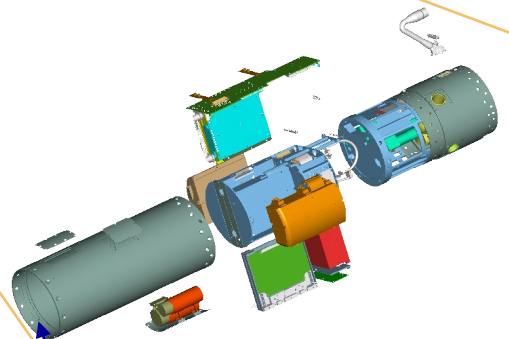
MMW Front-end

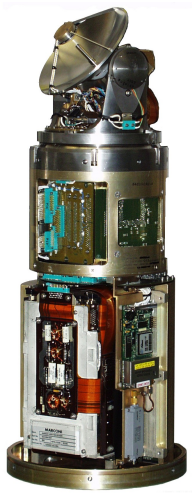
Seeker Electronics

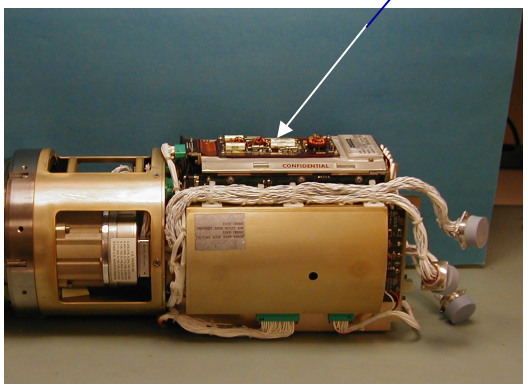


ARH Receiver

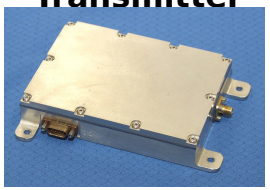
IMU/GPS







WIA Transmitter



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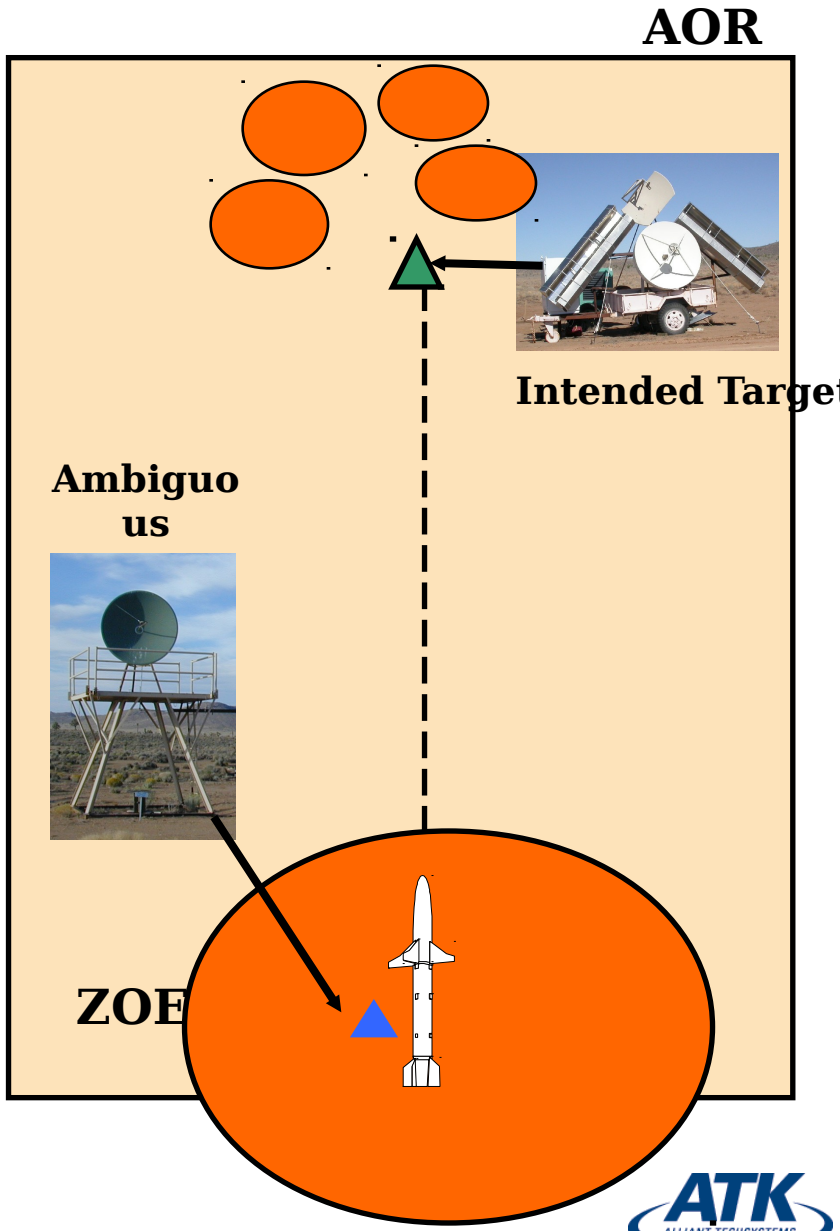
# Quick Bolt 2 Firing
## Engagement Scenario

- ***A/C Parameters*:**
  - **Medium Altitude**
  - **Medium Range**
- ***Missile Mode*:**
  - **Range Unknown**
- ***Target Location Error*:**
  - **TLE Medium (<10-15% of range)**
  - **Area of Responsibility (AOR) established prior to A/C launch**
  - **QB ENTR Off-board cue prior to msl launch**
- ***Target Type:***
  - **Typical SWA target**
  - **Ambiguous target located in AOR**
  - **Intended target shuts down with 30 seconds to go while ambiguous target continues transmitting**
- ***Constraints*:**
  - **Multiple zones of exclusion/impact avoidance zones (ZOE/IAZ) in AOR**

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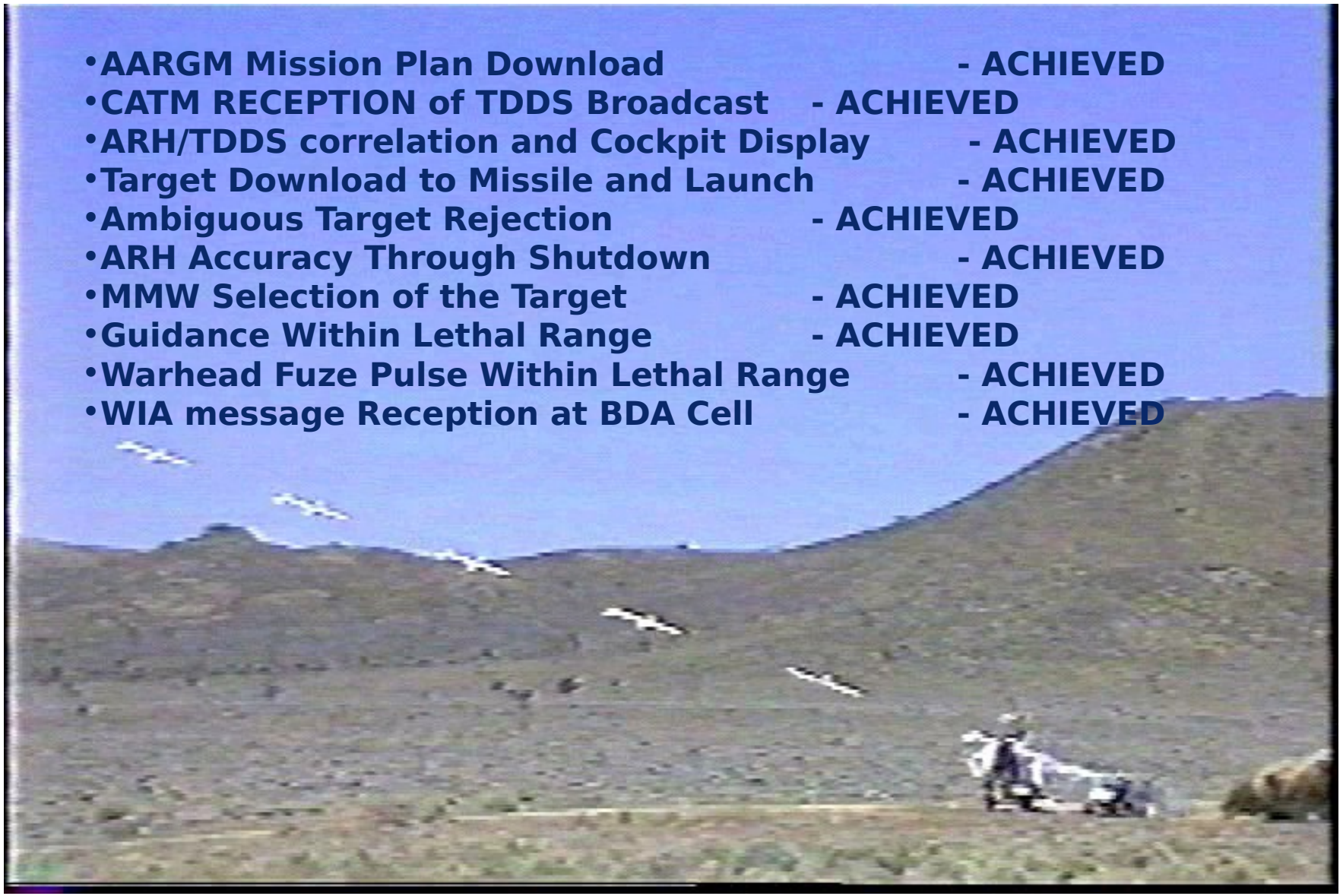
# Quick Bolt 2 Firing
## All Success Criteria Met


•AARGM Mission Plan Download - ACHIEVED
•CATM RECEPTION of TDDS Broadcast - ACHIEVED
•ARH/TDDS correlation and Cockpit Display - ACHIEVED
•Target Download to Missile and Launch - ACHIEVED
•Ambiguous Target Rejection - ACHIEVED
•ARH Accuracy Through Shutdown - ACHIEVED
•MMW Selection of the Target - ACHIEVED
•Guidance Within Lethal Range - ACHIEVED
•Warhead Fuze Pulse Within Lethal Range - ACHIEVED
•WIA message Reception at BDA Cell - ACHIEVED

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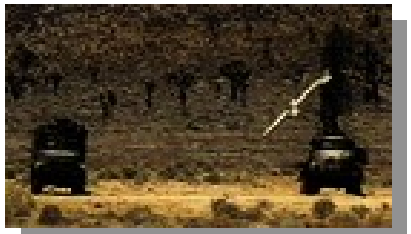
# AARGM/Quick Bolt Test Firing Summary

## Highly Successful Demonstration Programs



| | Launch Date | GPS | ARH | MMW | SHUT DOWN | GEO SPEC | WIA XMIT | ENTR CORR |
|---|---|---|---|---|---|---|---|---|
| CTV-1 | Mar 23, 2000 | √ | | | | | | |
| CTV-2 | June 19, 2000 | √ | | | | | | |
| GTV-1 | Aug 28, 2001 | √ | √ | | | | | |
| GTV-2 | Dec 21, 2001 | √ | √ | √ | | | | |
| GTV-3 | Aug 29, 2002 | √ | √ | √ | √ | √ | | |
| QB-1 | Nov 15, 2003 | √ | √ | √ | √ | √ | √ | |
| QB-2 | July 15, 2003 | √ | √ | √ | √ | √ | √ | √ |

**SUCCESS**

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# AGM-88E AARGM SD&D Program Overview

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# AARGM AGM-88E
## Performance Objectives

- **Improved Lethality:**
  - **Destroy current and projected *IADS* employing countermeasures including shutdown**
  - **Engage Elements of an ADU**
  - **Engage Non-Emitting Mobile/Time Sensitive/Non ADU Targets**
- **Reduced Fratricide**
  - **Geographic Specificity**
- **Improved Targeting**
  - **Wider FOV/Off-board Correlation**
- **Support Battle Damage Assessment**
- ***Affordable retrofit of existing HARM***

***The AARGM program will provide a cost-effective weapon that will detect, identify, engage and destroy current and projected enemy integrated air defenses (IADS) and other time-critical targets.***

# AARGM AGM-88E
## Enhanced Performance Capabilities

### ARH Subsystem

- Significantly enhanced sensitivity for improved threat detection
- Significantly enhanced direction finding accuracy for improved target location
- Significantly expanded field of view for improved situational awareness
- Expanded frequency coverage
- Correlation with off-board threat

### Navigation Subsystem

- Incorporation of SAASM GPS, precision IMU & DTED data
- Reduced fratricide via geographic specificity
- Expanded strike capabilities with PTP mode
- Increased probability of kill through accurate guidance
- Decreased vulnerability to GPS signal

- *Results in significantly improved capability to destroy existing and projected enemy air defense systems*
- *Provides tactical aircraft a significant new time sensitive strike capability*

- Off-board threat/targeting data via IBS receiver and correlation with ARH subsystem for enhanced threat location/verification/ situational awareness
- Weapon impact indication via WIA transmitter to verify weapon status/impact and to assist in the BDA process

- Counters threat radar shutdown tactics
- Expands target set to non-emitters
- Large search footprint to counter mobile/ moving targets
- Effective in presence of battlefield obscurants/ weather

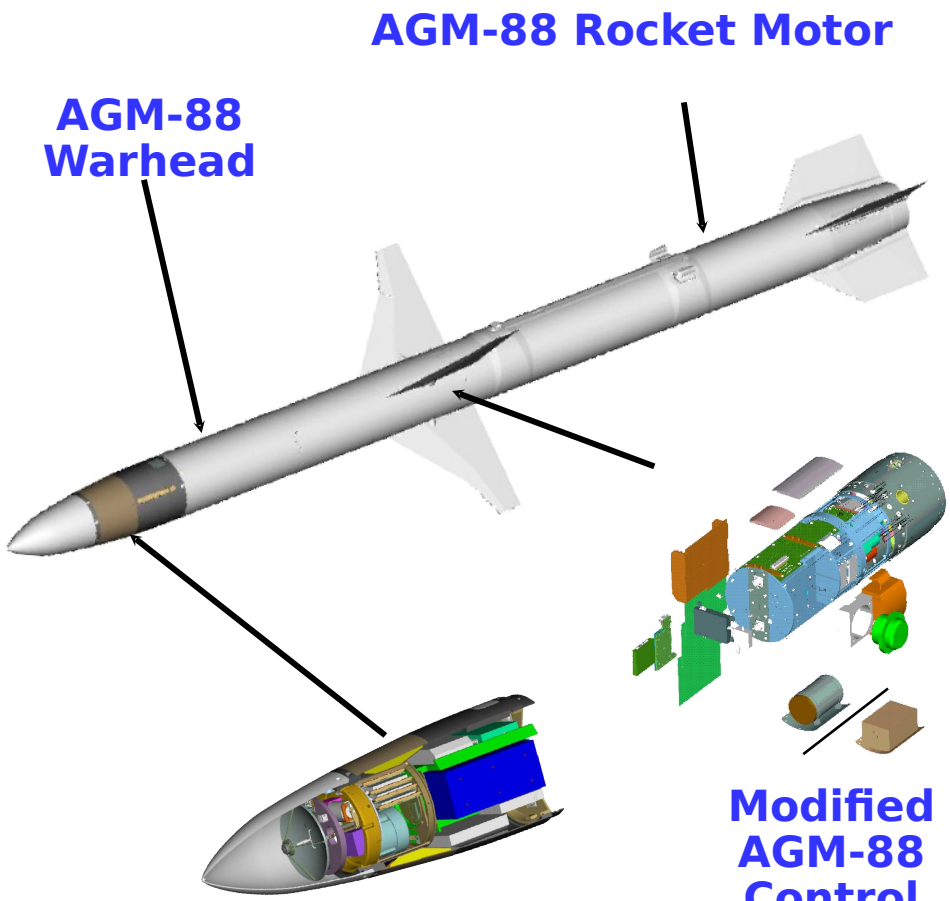
# AARGM AGM-88E
## Concept and Key Features

### Key Features

*Capabilities*
- Destroy Advanced IADS
- Provide Greater Lethality
- Ensure Geographic Specificity
- Support BDA Support/Situational Awareness

*Sensors*
- Digital ARH Receiver
- MMW Terminal Sensor
- DTED-aided SAASM GPS/INS
- National Systems Transmitter and Receiver

*Physical (Same as HARM)*
- Length - 164”
- Diameter - 10”
- Weight - 795 lbs

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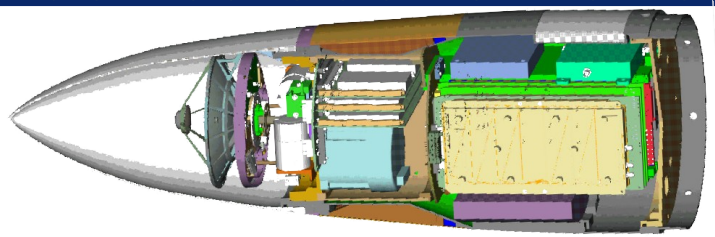
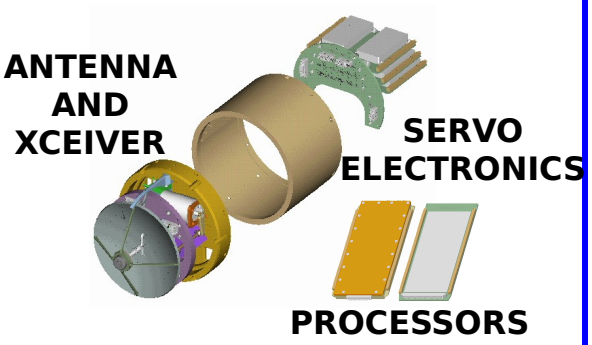
# AARGM AGM-88E
## Guidance Section Overview

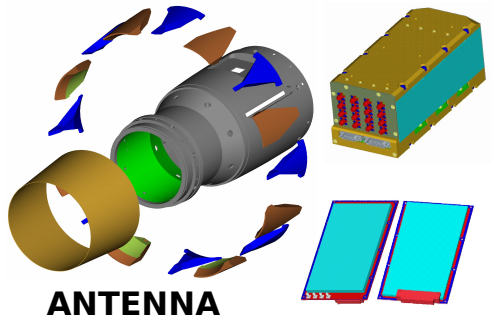


### Active Radar Seeker



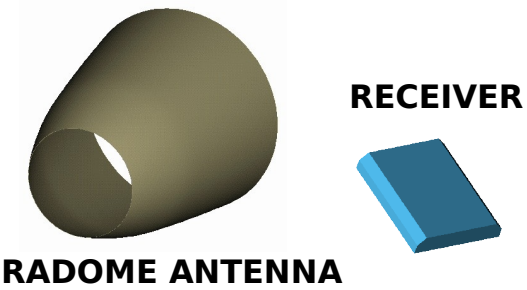

- Performs terminal target acquisition and track
- Large search area counters target movement/shutdown
- Expands AARGM target set to non-emitters

### Passive Anti-Radiation Homing Seeker




- Increased sensitivity, frequency band, and field-of-view with digital design
- Autonomous target detection, Identification
- Precision DF enables on-aircraft emitter location

### QB Receiver




- Receives off-board target information
- Fused with ARH data to form correlated target location/type/ track file
- Enables off-board targeting and enhanced cockpit situational awareness

***High-performance, multi-mode seeker ensures intended target destruction in countermeasures environment.***

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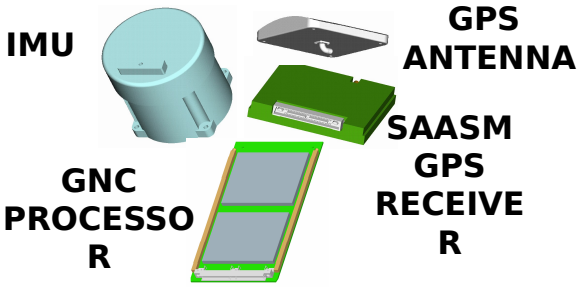
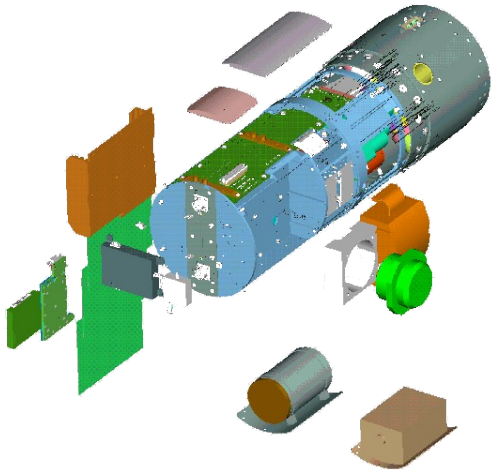
# AARGM AGM-88E
# Common Control Section

## Guidance, Navigation, and Control Subsystem




- High performance INS with tightly coupled IMU/SAASM GPS RCVR integrated with DTED data
- Enables fratricide reduction and precision target engagement



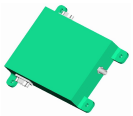
## Power Subsystem

- Power Supply
- Battery

## Weapons Impact Assessment Subsystem

ANTENNA

TRANSMITTER



- Connectivity with off-board sensors
- End game transmission of missile state and impact
- Enables near real-time BDA support
- Ensures weapons impact location verification

***Modular control section design allows for backward compatibility with legacy HARM weapons for precision navigation/point-to-point capabilities.***

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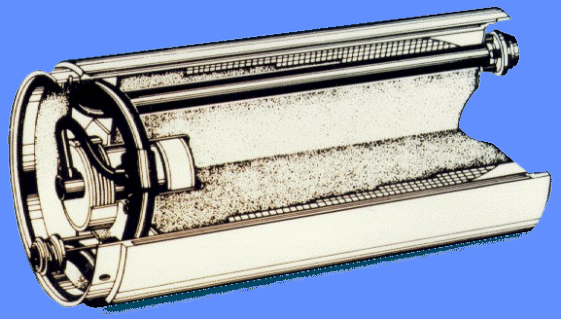
# AARGM AGM-88E Warhead
## Effective Against a Wide Range of Targets

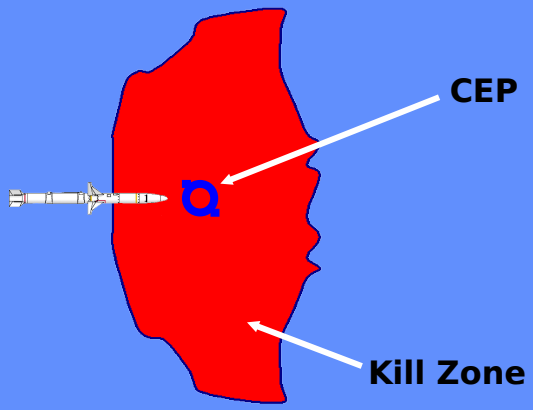
### Features

- Existing HARM WAU-7/B
- Blast/Fragmentation Design
- 144 Pounds
- > 25,000 Steel Fragments
- PBXN-107 Explosive

### Design



### Blast Pattern




### Effects

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# AARGM AGM-88E
## Interfaces and Compatibility

### Aircraft

**Baseline Integration Platform**

**Potential Integration Platforms**

### Interfaces

- **1553 and HARM Legacy Data**
  - Compliant with HARM-PNU AS-5186/5108 Interface Specifications
  - MIL-STD-1760C Class II Interface Capable
- **Standard A/C Power**
  - 3 phase 115 VAC, 400 Hz, < 500 W
- **Direct National Asset Connectivity**

### Environment

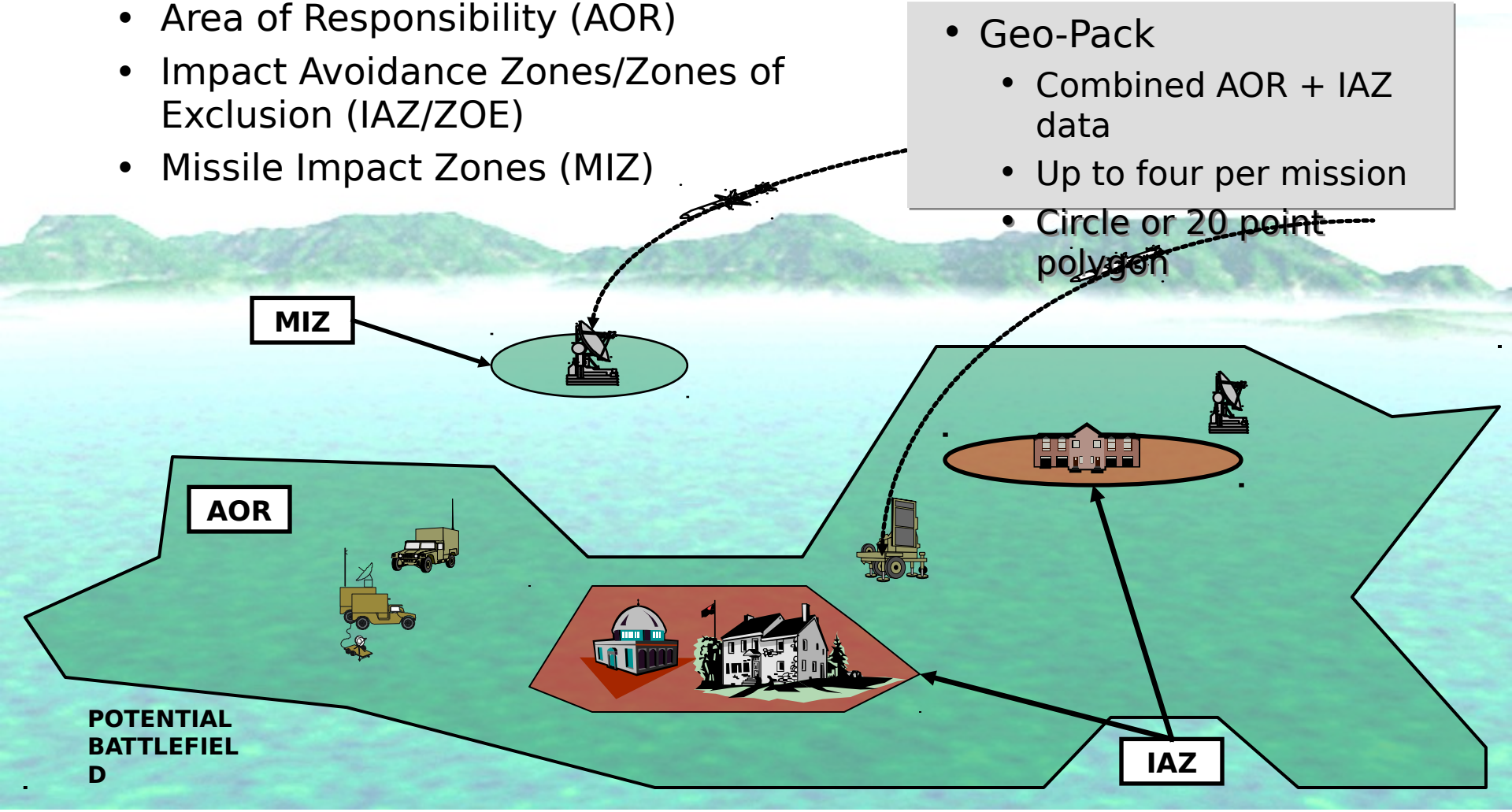
- Compliant with F/A-18 C/D/E/F/G vibration environment
- Designed to withstand 200+ catapult launches & trap landings
- -40º to +71º C Operational Temperature range
- Adverse Weather Availability (Rain, fog, clouds, snow)
- EMI Resistant (Tailored Mil-Std 464, Shipboard Emitters)

# AARGM AGM-88E
## Geographic Specificity

Employment in restrictive ROE

- Area of Responsibility (AOR)
- Impact Avoidance Zones/Zones of Exclusion (IAZ/ZOE)
- Missile Impact Zones (MIZ)

- Geo-Pack
  - Combined AOR + IAZ data
  - Up to four per mission
  - Circle or 20 point polygon

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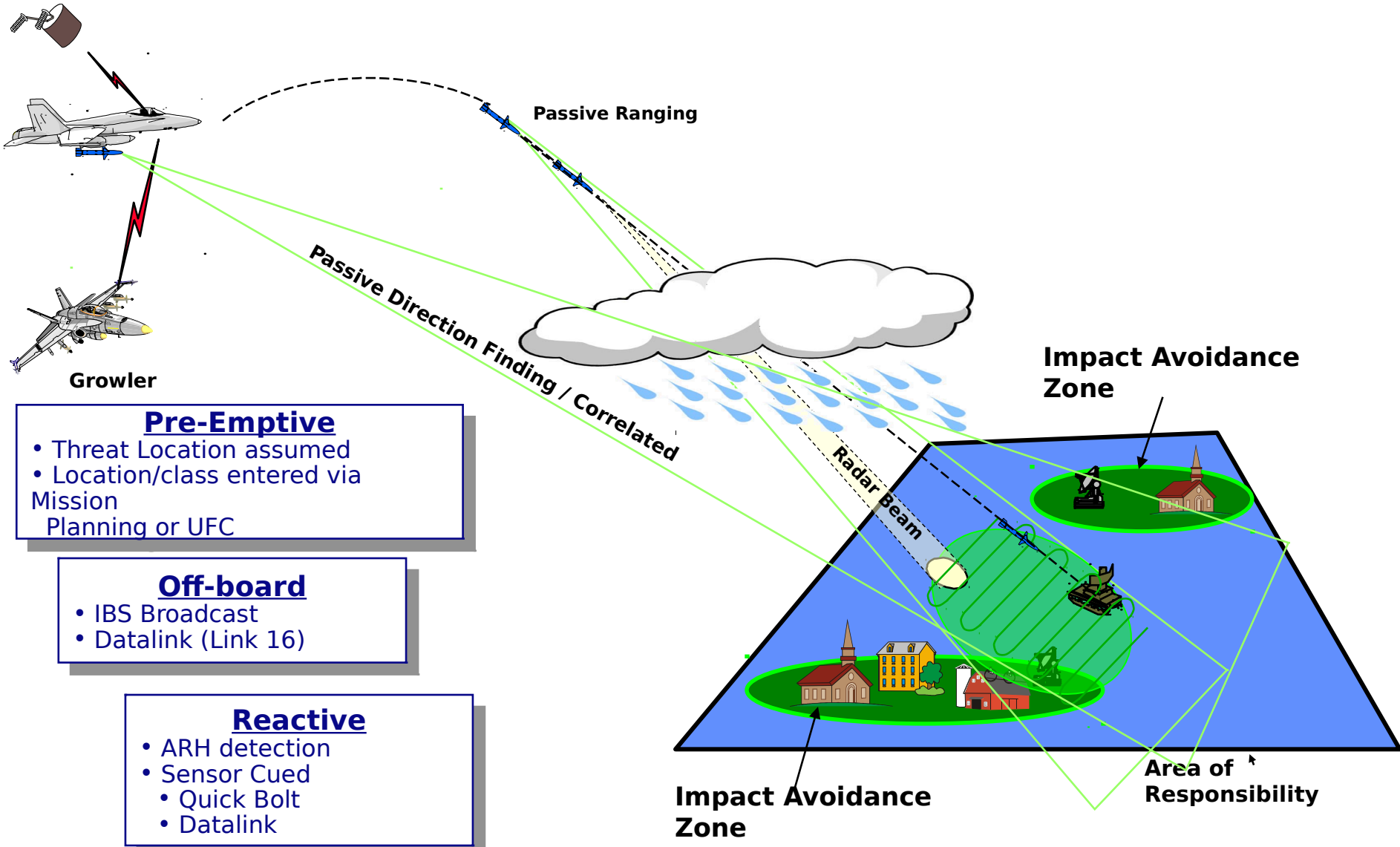
# AARGM AGM-88E
## Targeting Options




**Pre-Emptive**
- Threat Location assumed
- Location/class entered via Mission Planning or UFC

**Off-board**
- IBS Broadcast
- Datalink (Link 16)

**Reactive**
- ARH detection
- Sensor Cued
  - Quick Bolt
  - Datalink

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# AARGM Program Summary

- **ATD/Quick Bolt ACTD successfully completed July 2003**
- **SD&D contract ($222.6M) signed June 03**
  - **Efforts planned through September 2008**
- **Production is planned from 2008 through 2015**
  - **Production run estimated at 1750 units for USN**
  - **Potential for one year acceleration for LRIP with recent Navy budget actions**
- ***AARGM program is on track to deliver a greatly enhanced SEAD/strike capability to USN***
  - ***Provisions are under way to address international interest***

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# Contacts

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